**HISTORICAL GEOLOGY**

LAB REPORT – 81 pts.

Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Group #: \_\_\_\_\_\_\_\_

Period: \_\_\_\_\_\_\_\_

**OBJECTIVE:** To compare and contrast relative dating techniques and absolute dating techniques

**QUESTION:** How can we determine if one rock layer is older than another?

**HYPOTHESIS:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ **(1 pt.)**

**MATERIALS:**

* 20 Skittles
* Glass jar
* Graph paper
* Metric ruler
* Syllable and Fossil cutout cards
* Paper towel
* Colored pencils
* 1 lab report sheet per student

**INTRODUCTION:**

It is estimated the age of the earth is approximately 4.5 billion years old. This estimation comes from years of geologic study in an effort to try an determine both **relative age**, the age of an object, such as rock, in relation to the ages of other objects around it by studying rock layers, and **absolute age**, the numeric age of a rock formation. A **fossil** is the remains or physical evidence of an organism preserved by geologic processes. The scientific study of these fossils is known as **paleontology** while the people who study different categories of fossils are named **paleontologists**.

**PROCEDURE:**

1. Spread the syllable cutout cards out at your lab station and determine the correct sequence of the eight cards by comparing letters that are common to individual cards and, therefore, overlap.
2. The first card in the sequence is the “TC” card. This card represents the bottom of the sequence. If the letters "T" and "C" represent fossils in the oldest rock layer, they are the oldest fossils, or the first fossils formed in the past for this sequence of rock layers.
3. Now, look for a card that has either a "T" or "C" written on it. Since this card has a common letter with the first card, it must go on top of the "TC" card. The fossils represented by the letters on this card are "younger" than the "T" or "C" fossils on the "TC" card which represents fossils in the oldest rock layer. Sequence the remaining cards by using the same process. When you finish, you should have a vertical stack of cards with the top card representing the youngest fossils of this rock sequence and the "TC" card at the bottom of the stack representing the oldest fossils.
4. After you have arranged the cards in order, write your sequence of letters, using each individual letter only once. Start with the top card and the letter furthest to the right so the letters below are in order from youngest to oldest. **(11 pts.)**
5. \_\_\_\_\_ *(Youngest)*
6. \_\_\_\_\_
7. \_\_\_\_\_
8. \_\_\_\_\_
9. \_\_\_\_\_
10. \_\_\_\_\_
11. \_\_\_\_\_
12. \_\_\_\_\_
13. \_\_\_\_\_
14. \_\_\_\_\_
15. \_\_\_\_\_ *(Oldest)*
16. Based on your above sequencing, answer the following questions: **(3 pts.)**
17. How do you know that "X" is older than "M"? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
18. Explain why "D" in the rock layer represented by DM is about the same age as "M." \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
19. Explain why "D" in the rock layer OXD is older than "D" in the rock layer DM. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
20. Carefully examine the fossil cutout cards which have sketches of fossils on them. Each card represents a particular rock layer with a collection of fossils that are found in that particular rock stratum. All of the fossils represented would be found in sedimentary rocks of marine origin. The next page of this lab report gives some background information on the individual fossils.
21. The oldest rock layer is marked with the letter "M" in the lower left-hand corner. The letters on the other cards have no significance to the sequencing procedure and should be ignored at this time. Find a rock layer that has at least one of the fossils you found in the oldest rock layer. This rock layer would be younger as indicated by the appearance of new fossils in the rock stratum. Keep in mind that extinction is forever. Once an organism disappears from the sequence it cannot reappear later.
22. Use this information to sequence the cards in a vertical stack of fossils in rock strata. Arrange them from oldest to youngest with the oldest layer on the bottom and the youngest on top.
23. Using the letters printed in the lower left-hand corner of each card, write the sequence of letters below from the youngest to oldest (i.e., from the top card to the bottom). **(8 pts.)**
    1. \_\_\_\_\_ *(Youngest)*
    2. \_\_\_\_\_
    3. \_\_\_\_\_
    4. \_\_\_\_\_
    5. \_\_\_\_\_
    6. \_\_\_\_\_
    7. \_\_\_\_\_
    8. \_\_\_\_\_ *(Oldest)*
24. Based on your above sequencing, answer the following questions: **(6 pts.)**
25. Which fossil organisms could possibly be used as index fossils (use fossils appearing two times or less with exception of the shark tooth since that represents current time)?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Name 3 organisms that probably could not be used as index fossils and explain why.   
   \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. In what kinds of rocks might you find the fossils from this activity? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. State the Law of Superposition and explain how this activity illustrates this law. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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| **Sketches of Marine Fossil Organisms (Not to Scale)** | | |
| Brachiopod | Trilobite | Eurypterid |
| NAME: Brachiopod PHYLUM: Brachiopoda DESCRIPTION: "Lampshells"; exclusively marine organisms with soft bodies and bivalve shells; many living species | NAME: Trilobite PHYLUM: Arthropoda DESCRIPTION: Three-lobed body; burrowing, crawling, and swimming forms; extinct | NAME: Eurypterid PHYLUM: Arthropoda DESCRIPTION: Many were large (a few rare species were 5 feet in length); crawling and swimming forms; extinct |
| Graptolite | Horn coral | Crinoid |
| NAME: Graptolite PHYLUM: Chordata DESCRIPTION: Primitive form of chordate; floating form with branched stalks; extinct | NAME: Horn coral PHYLUM: Coelenterata (Cnidaria) DESCRIPTION: Jellyfish relative with stony (Cnidaria)(calcareous) exoskeleton found in reef environments; extinct | NAME: Crinoid PHYLUM: Echinodermata DESCRIPTION: Multibranched relative of starfish; lives attached to the ocean bottom; some living species ("sea lilies") |
| Placoderm | Foraminifera | Gastropod |
| NAME: Placoderm PHYLUM: Vertebrata DESCRIPTION: Primitive armored fish; extinct | NAME: Foraminifera (microscopic type) PHYLUM: Protozoa (Sarcodina) DESCRIPTION: Shelled, amoeba-like organism | NAME: Gastropod PHYLUM: Mollusca DESCRIPTION: Snails and relatives; many living species |
| Pelecypod | Ammonite | Ichthyosaur |
| NAME: Pelecypod PHYLUM: Mollusca DESCRIPTION: Clams and oysters; many living species | NAME: Ammonite PHYLUM: Mollusca DESCRIPTION: Squid-like animal with coiled, chambered shell; related to modern-day Nautilus | NAME: Icthyosaur PHYLUM: Vertebrata DESCRIPTION: Carnivore; air-breathing aquatic animal; extinct |
|  | Shark's tooth | NAME: Shark's tooth PHYLUM: Vertebrata DESCRIPTION: Cartilage fish; many living species |

1. Using the geological cross-sections below, answer the following questions: **(19 pts.)**



* 1. Of the two sequences of rocks in the above cross-section, A-D and E-G, which were disturbed by crustal movement after its deposition?

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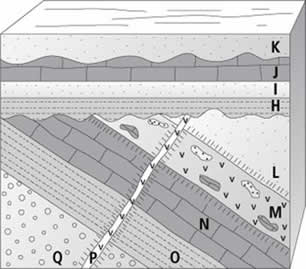
* 1. Determine the sequence of events for the above cross-section from oldest to youngest.

1. \_\_\_\_\_ *(Oldest)*
2. \_\_\_\_\_
3. \_\_\_\_\_
4. \_\_\_\_\_
5. \_\_\_\_\_
6. \_\_\_\_\_
7. \_\_\_\_\_
8. \_\_\_\_\_ *(Youngest)*



* 1. Determine the sequence of events for the above cross-section from oldest to youngest.

1. \_\_\_\_\_ *(Oldest)*
2. \_\_\_\_\_
3. \_\_\_\_\_
4. \_\_\_\_\_
5. \_\_\_\_\_
6. \_\_\_\_\_
7. \_\_\_\_\_
8. \_\_\_\_\_ *(Youngest)*
9. Using the diagram below, determine the sequence of events, corresponding to the lettered rock layers, and order them below from oldest to youngest. Be careful of layer “M” and “P” as both are igneous intrusions, meaning they came *through* pre-existing rock. **(10 pts.)**



1. \_\_\_\_\_ *(Oldest)*
2. \_\_\_\_\_
3. \_\_\_\_\_
4. \_\_\_\_\_
5. \_\_\_\_\_
6. \_\_\_\_\_
7. \_\_\_\_\_
8. \_\_\_\_\_
9. \_\_\_\_\_
10. \_\_\_\_\_ *(Youngest)*
11. Rinse your glass jar thoroughly using a drop of soap and water at your lab station sink.
12. Retrieve a piece of graph paper from the center lab station, placing your name and period number on the back of it. The orientation of your graph paper should be landscape (long-ways) and label the x-axis of the graph “Number of Half-Lives”. Beginning at the point furthest to the left of the x-axis, evenly space out numbers 0 through 10. Label the y-axis “Number of Parent Isotopes”. Beginning at the point furthest down the y-axis, evenly space out numbers 0 through 100 in increments of 20. Set the graph paper aside for now.
13. Place all 20 Skittles on the paper towel with the printed “S” facing down. This represents the radioactive parent isotope.
14. The candy should then be placed into the glass jar followed by sealing the lid. Shake the glass jar thoroughly, then pour the Skittles randomly back onto the paper towel so they are spread out rather than making a pile. For all intents and purposes of this lab activity, the first time of shaking represents one “half life”, even though more or less than half may be remaining. All of the pieces of candy that have the printed “S” facing up represent a change (decay) to the stable daughter isotope. Each shake thereafter represents another “half life”.
15. Pick up and set aside ONLY those pieces of candy with the “S” facing up. Then, count the number of pieces of candy left with the “S” facing down. These are the radioactive parent isotopes that did not change (decay) during the first “half life”.
16. Continue this process 9 more times until you have a total of 10 half-lives reached. As you progress through, fill in the data table of the following page.

|  |  |  |
| --- | --- | --- |
| **Number of Half-Lives** | **Parent Isotopes** | **Daughter Isotopes** |
| 0 | 100 | 0 |
|  |  |  |
|  |  |  |
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1. After the results of the final "half life" of the Skittles are collected, they are no longer needed. Divide the Skittles evenly with the members of your lab group only if you properly cleaned the glass jar before use. Otherwise, dispose of them properly in the nearest garbage can.
2. Plot all of your collected data from the above data table on your graph paper. Connect each successive point on the graph with a red-colored line. On the same graph plot points where, after each "shake", the starting number is divided by exactly two (a true “half life” and connect these points by a blue-colored line. This line begins at 100; the next point is 100/ 2, or 50; the next point is 50/2, or 25; and so on. Staple the graph to the back of this lab report. **(10 pts.)**
3. Make sure all materials are put back in the lab basket at your lab station, including making sure all cutouts are paper-clipped backed together in their appropriate piles.

**LAB QUESTIONS (1 pt. each) –** *Please write your answers in* ***COMPLETE SENTENCES****!*

1. For the Skittles portion of this lab report, why did every lab group get different results?

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1. Who is considered the “father of modern geology”?

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1. Define uniformitarianism.

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1. Describe different ways of determining the *relative* age of various rock layers.

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1. What are the 3 types of unconformities?

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1. Describe different ways of determining the *absolute* age of various rock layers.

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1. What is radiometric dating and how did you utilize it in this lab?

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1. Name the 7 common types of radiometric dating methods.

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1. Differentiate between the 3 types of paleontologists.

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1. What are some different forms of fossil preservation?

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**CONCLUSION (5 pts.) –** *Write a solid paragraph (at least 5 sentences) about your conclusions from the lab. Discuss the steps you went through during your lab experiment, what you accomplished, and how you tested your hypothesis. Also include what you learned as a result of this lab experiment.*

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